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EDITORIAL

Preface

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In the context of global warming, reduction of greenhouse gas (GHG) emissions and decrease of natural resources, it is necessary to propose innovative concepts to make waste and wastewater treatment more sustainable.

Environmental engineering was born with wastewater treatment and the need to supply safe water, remove wastes from water and protect public health. In the last decades, protection of the receiving environment has become an actual issue and nutrient removal has been developed to prevent eutrophication and contamination of surface and ground water. More recently, a special attention has been given to greenhouse gas emissions in waste and wastewater treatment, especially methane (CH_4) and nitrous oxide (N_2O).

The most widely used wastewater treatment system is the activated sludge process, in which soluble organic matter is converted to CO_2 and a microbial biomass called sludge. When nutrient removal is applied, nitrogen is converted to molecular nitrogen by nitrification/denitrification and phosphorus is removed by chemical precipitation or, in some cases, enhanced biological phosphorus removal.

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Treatment and disposal of sewage sludge from wastewater treatment plants account for about half, even up to 60%, of the total cost of wastewater treatment. Main alternative methods for sludge disposal are landfill, land application and incineration. However, land application, which could appear as the most sustainable solution, has been highly restricted to prevent health risks due to potentially toxic elements such as heavy metals, pathogens and organic micro-pollutants. A lot of research has been done to develop strategies for reducing excess sludge production (Ødegaard 2004). Sludge minimization may be a result of reduced production of sludge and/or disintegration processes that may take place both in the wastewater treatment stage and in the sludge stage. But high energy consumption is necessary for aeration, especially when working at a high sludge age to minimize sludge production and promote nitrification, and disintegration processes.

An alternative approach is to consider wastewater as a potential source of organic carbon, nutrient, energy and, last but not least, water (Verstraete et al. 2009). The idea here is to move from removal, the main process involved in an activated sludge treatment, to recovery. The main problem to deal with is the high dilution of these products, especially in municipal wastewater that is the most important available stream. One option is to prevent dilution: urine separation is a means of direct recovery, as 80% of the nitrogen and 45% of the phosphorus in municipal wastewater originate from urine

(Wilsenach and van Loosdrecht 2004). The other way is to re-concentrate the nutrients that have been diluted in municipal wastewater. In this case, the activated sludge process should be operated at low sludge age and high loading rate to favor sludge production in which nutrients will accumulate. The sludge can then be anaerobically digested producing energy, as biogas, and a concentrated nutrient liquor. In both cases, processes are existing or emerging to recover nutrients, especially phosphorus as struvite or calcium phosphate, to be used as fertilizers in agriculture.

To go further in the idea of sustainable waste and wastewater treatment, it could be possible to apply the concept of biorefinery to environmental biotechnology. The term biorefinery refers to the fractionation and conversion of biomass feedstock into biofuel, bioenergy and biomaterials with minimum waste and emissions (Ragauskas et al. 2006). This concept could be applied using waste and wastewater as the biomass feedstock and thus be called environmental biorefinery. In this context, anaerobic digestion, coupled to various physic-chemical pretreatments, could be one of the key-processes of this environmental biorefinery, with the potential production of energy (hydrogen, methane, …), primary chemicals (ethanol, volatile fatty acids, lactate), concentrated nutrient stream (N, P, …), and water. Tilche and Galatola (2008) recently showed that biogas production may considerably contribute to GHG emission reductions, in particular if used as a biofuel, and that its use as a biofuel may allow for true negative GHG emissions, showing a net advantage with respect to other biofuels.

Finally, the environmental biorefinery vision should contribute significantly to the requested development of renewable energy resources based on sustainable bioresources. To address this challenge, the joint effort of microbiologists, (bio)chemists and (bio)chemical engineers is needed.

RESB is the appropriate journal to publish review articles dealing with all aspects of environmental biorefineries. Such a topic should also encourage the submission of horizon papers in which authors are free to give their opinion on a topic in the scope of the journal.

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